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(54) Cellular Radio Network

(57) The present invention relates generally to the field of cellular radio networks and a method for operating cellular radio networks, particularly a method for providing adaptive neighbour cell lists for a cellular radio network.

In cellular radio networks handovers are used to hand over a call from one cell to an other. To identify possible cells for handovers neighbour cell lists are used for each cell containing information on neighbouring cells. Due to system limitations these neighbour cell lists sometimes do not contain all available neighbouring cells.

The present invention overcomes this disadvantage by providing a method that allows to adapt the neighbour cell lists according to the actual location of a mobile station and the actual reception conditions at the time the mobile station is operative.

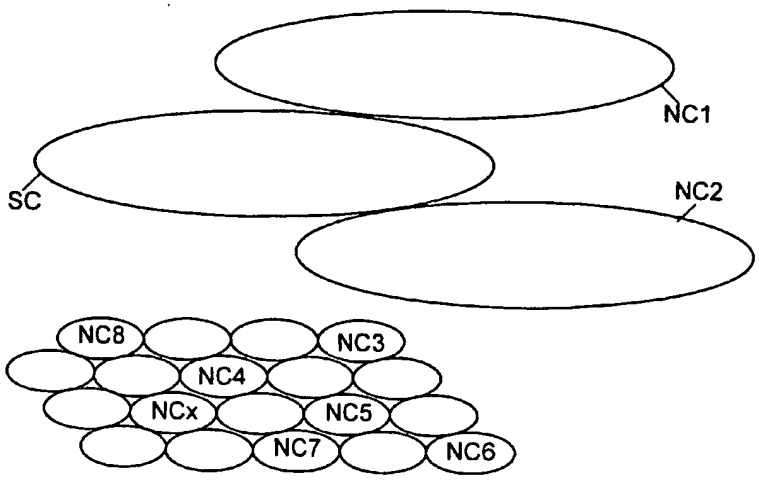

Fig. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates generally to the field of cellular radio networks and a method for operating cellular radio networks, particularly a method for providing adaptive neighbour cell lists for a cellular radio network.

BACKGROUND OF THE INVENTION

[0002] The basic idea underlying cellular radio networks is to use within a limited band width only a given number of frequencies for setting up radio channels. The given frequencies are used several times to provide the traffic capacity required despite the limited bandwidth. For this purpose every cell of the cellular radio network uses only one frequency or a subset of frequencies from within the available bandwidth. Neighbouring cells do have different frequencies or subsets of frequencies. Cells using the same frequency or subset of frequencies are located sufficiently far from each other. In that way signal strengths of the different radio channels represented by the different frequencies have decreased sufficiently in order to avoid disturbances caused from co-channel interference.

[0003] In order to achieve seamless coverage and to support the traffic capacity required, a number of system parameters for the design of the cellular radio network has to be considered, e. g. traffic intensity in different areas, maximum transmission power and interference. When the design of a cellular radio network is completed, a dedicated group of frequencies is allocated to each cell, i. e. a number of carriers having the given frequencies.

[0004] Ongoing calls are handled by the cellular radio networks by using handovers. If a mobile station (MS) having an ongoing call leaves one cell or if the reception conditions for that cell, i. e. the reception conditions for the frequency used, deteriorate the MS is handed over to that neighbouring cell which offers the best reception. To achieve this, handover algorithms are used in the cellular radio network. Usually the MS monitors the reception quality of the serving cell and a number of neighbouring cells and sends the information on the reception quality to a base station transceiver (BTS) of the serving cell. The information is then transmitted to a base station controller (BSC). BTS or BSC decides on necessary handovers. The BSC provides a list to the MS, containing the neighbour cells of the serving cell which have to be monitored by the MS. In common cellular radio networks the size of the neighbouring cell list is limited, e. g. to information on 32 neighbouring cells. This limitation causes a restrictions to the operability of the cellular radio network, if the cellular radio network has a complex cell structure employing e. g. macro cells with an underlying structure of micro cells. For complex cell structures like the mentioned one, the limitation to 32 neighbouring cells in the neighbouring cell list may cause problems to identify the cell offering the best reception, because not all neighbouring cells can be monitored.

SUMMARY OF THE INVENTION

[0005] Accordingly, it is an object of the present invention to provide a method for providing neighbour cell lists for a cellular radio network. It is the aim of the inventive method under consideration to avoid the drawbacks known from the state of the art.

[0006] The object is achieved by providing a method for operating a cellular radio network having neighbour cell lists comprising steps of

providing a first part of the neighbour cell list containing information on fixed neighbour cells, and
providing a second part of the neighbour cell list containing information on varying neighbour cells.

[0007] It is an advantage of the present invention, that it allows to adapt the neighbour cell lists according to the actual location of a mobile station and the actual reception conditions at the time the mobile station is operative.

[0008] The present invention will become more fully understood from the detailed description given hereinafter and further scope of applicability of the present invention will become apparent. However, it should be understood that the detailed description is given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The following detailed description is accompanied by drawings of which

Fig. 1 is an illustration for a first neighbour cell list showing a section of a cellular radio network having macro and micro cells, and

Fig. 2 is an illustration for a second neighbour cell list showing a section of a cellular radio network having macro and micro cells.

[0010] Identical denotations in different Figures represent identical elements.

DETAILED DESCRIPTION

[0011] Although the present invention is suited for all kinds of cellular radio networks employing mobile assisted cellular handover, it will be explained in the following by using a cellular radio network based on the Global System for Mobile communications (GSM) as an

example. For greater detail of the GSM standard reference is made to "The GSM system for Mobile Communications", M. Mouly and M.-B. Pautet, Palaiseau, France, 1992, ISBN No. 2-9507190-0-7. In Fig. 1 a section of a cellular radio network having macro cells and micro cells is shown. One macro cell SC is considered to be a serving cell, i. e. a macro cell which actually is used to connect a mobile part of the cellular radio network to a fixed part of the cellular radio network. As e. g. explained in greater detail in the above mentioned reference, the mobile part is being formed by a mobile station (MS), whereas the fixed part is being formed by at least one mobile switching centre (MSC) which e. g. connects the cellular radio network to a publicly switched telephone network. To the MSC one or more base station controllers (BSC) are connected which control base transceiver stations (BTS). Radio equipment of the BTSs forms the cells which are used for radio connecting the MSs to the fixed part of the cellular radio network. During the call the MS measures the reception level or the reception quality of neighbouring cells. To enable the MS to do so, the fixed part of the cellular radio network, e. g. the serving BSC, sends a neighbour cell list containing information on neighbouring cells via the serving BTS to the MS. The neighbour cell list is set up or generated by an operator at the time of network planning for each cell being used in the cellular radio network. Due to the system limitation of e. g. 32 neighbouring cells per neighbour cell list, as mentioned earlier, it is not always possible to measure all neighbouring cells of the actual serving cell.

[0012] To overcome this problem the neighbour cell lists are separated in a first and a second part. The first part of a neighbour cell list contains information on neighbouring cells being members of a higher cell hierarchy, e. g. in Fig. 1 macro cells NC1 and NC2 are contained in the first part of the neighbour cell list of cell SC. Cells NC1 and NC2 can be defined by an operator or can be the so called first tier cells, i. e. directly neighbouring cells. The second part of a neighbour cell list contains information on neighbouring cells being members of a lower cell hierarchy, e. g. in Fig. 1 micro cells NC3 to NC8 and NCx, covered by the serving cell SC of the higher hierarchy. The start information contained in the second part of the cell list has to be defined by an operator and has to be an adequate subset of the available micro cells, e. g. micro cells equally distributed over the coverage area of the serving cell SC.

[0013] During a call the MS measures e. g. the receive levels of all neighbouring cells contained in the neighbour cell list, i. e. information available in the first and second part of the neighbour cell list, and sends the measured receive levels via the serving BTS to the serving BSC. If the measurements show that one of the micro cells, e. g. micro cell NCx, contained in the second part of the neighbour cell list offers sufficiently good reception conditions, the BCS generates a new second part of the neighbour cell list which replaces the previously used second part of the neighbour cell list. If more than one micro cell show sufficiently good reception conditions, the micro cell having the best reception conditions is chosen. If no micro cell offers sufficiently good reception conditions no change is made. The decisions on the reception conditions e. g. can be made based on an averaged receive level for the cells being part in the respective neighbour cell list.

[0014] The micro cells contained in the generated second part of the neighbour cell list, as shown in Fig. 2, contain micro cell NCx which previously was found to be the best cell and all first tier micro cells N3 to N8 of micro cell NCx. In addition to first tier micro cells, which can be determined automatically by the BSC, additional micro cells can be defined by an operator as belonging to e. g. micro cell NCx, i. e. the additional micro cells will be added to the list in case micro cell NCx has been identified as best cell as described above. If for one micro cell N3 to N8 being part of the generated second part of the neighbour cell list which has been sent to the MS better receive conditions are measured than for micro cell NCx, a new second part of the neighbour cell list is generated having that micro cell as a centre with its first tier micro cells. If no better micro cell can be identified the call is handed over to the best micro cell, e. g. micro cell NCx.

[0015] If it shows at the time of generation of a new second part of the neighbour list that the limitation of e. g. 32 neighbouring cells is exceeded, the members of the second part of the neighbour cell list can be limited to that micro cells being specified by the operator, as mentioned above, and that micro cells automatically calculated by the BSC having the best reception conditions, in order to fulfil the given limitation. For a neighbour cell list having a first part containing e. g. 15 macro cells, the second part only can contain 17 micro cells.

[0016] The above mentioned operator defined cells are especially of advantage e. g. in a so called line of sight scenario, i. e. a location that allows the reception of a distant macro cell, which normally can not be received at that location. One such location is a high building where a MS, located at a higher level, may receive a macro cell normally not available. To cover this scenario the operator defines micro cells for locations showing line of sight reception and adds them to the second part of the neighbour cell list for the distant macro cell.

Claims

1. A method for operating a cellular radio network having neighbour cell lists comprising steps of

   providing a first part of the neighbour cell list containing information on fixed neighbour cells, and

   providing a second part of the neighbour cell list containing information on varying neighbour

cells.

2. A method according to claim 1,
characterised in that,
said second part of the neighbour cell list is determined based on measurements of a receive level.

3. A method according to claim 1,
characterised in that,
said second part of the neighbour cell list is determined based on measurements of reception quality.

4. A method according to one of the claims 1 to 3,
characterised in that,
said second part of the neighbour cell list is being formed by a specific neighbour cell list defined for each cell.

5. A method according to claim 5,
characterised in that,
one specific neighbour cell list is chosen depending on said measurement results, identified by one cell having the best measurement result and being a member of said first or current second part of the neighbour cell list.

6. A method according to one of the claims 1 to 5,
characterised in that,
said first part of the neighbour cell list contains information on macro cells.

7. A method according to one of the claims 1 to 6,
characterised in that,
said specific neighbour cell lists contain information on micro cells.

8. A method according to one of the claims 1 to 7,
characterised in that,
all neighbour cell lists are sent from a fixed part of the cellular radio network to a mobile part of the cellular radio network.

9. A method according to one of the claims 1 to 8,
characterised in that,
said information on neighbour cells of said first part of the neighbour cell lists and information on the neighbour cells of said specific neighbour cell lists are defined as part of network planning.

10. A method according to one of the claims 1 to 9,
characterised in that,
the cellular radio network is a GSM network.

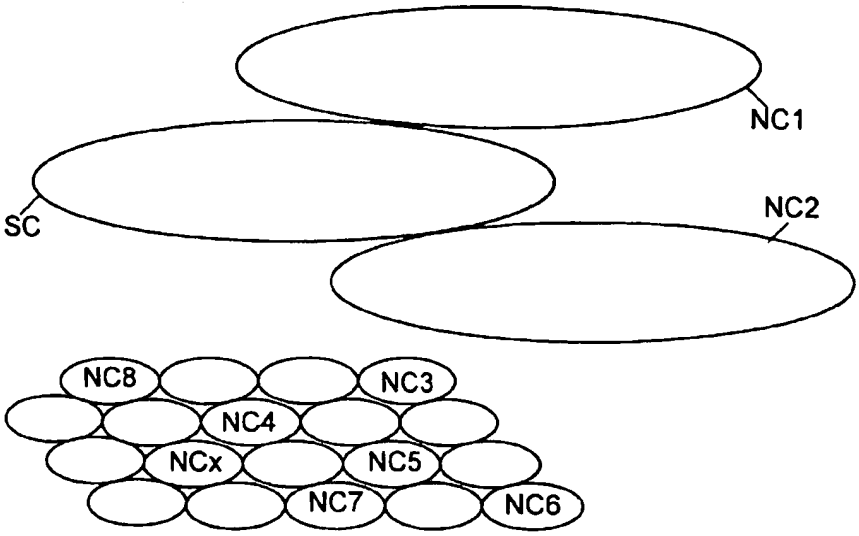
NC1
SC
NC2
NC8
NC3
NC4
NCx
NC5
NC7
NC6

Fig. 1

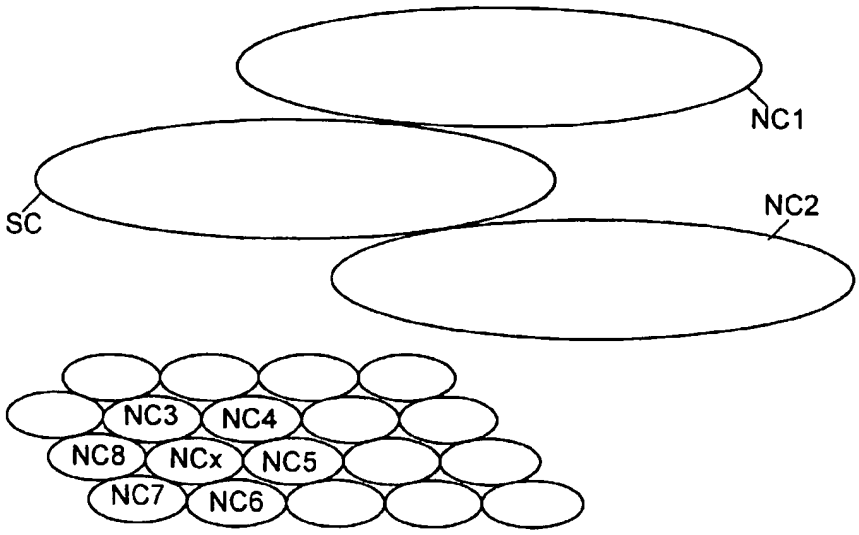
NC1
SC
NC2
NC3
NC4
NC8
NCx
NC5
NC7
NC6

Fig. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 30 7490

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	WO 97 32445 A (ERICSSON TELEFON AB L M) 4 September 1997 * page 8, line 1 - page 10, line 23 * * page 17, line 25 - page 20, line 21 * * page 21, line 24 - page 23, line 7 * * page 23, line 28 - page 24, line 7 * * page 24, line 19 - page 27, line 9 * * page 27, line 22 - page 29, line 1 * * page 29, line 23 - page 32, line 2 * * page 32, line 21 - line 31 * * page 41, line 26 - page 42, line 15 *	1-10	H04Q7/38 H04Q7/22
X	US 5 428 816 A (BARNETT CHARLES A ET AL) 27 June 1995 * column 5, line 34 - column 6, line 2 * * column 7, line 46 - column 8, line 10 * * column 6, line 63 - column 7, line 23 *	1-6	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6) H04Q

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11 February 1999	Gerling, J.C.J.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 98 30 7490

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report
The members are as contained in the European Patent Office EDP file on
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11-02-1999

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9732445 A	04-09-1997	US 5854981 A	29-12-1998
		AU 2109797 A	16-09-1997
		EP 0883970 A	16-12-1998
US 5428816 A	27-06-1995	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82